FORESTRY RESEARCH

WHAT'S NEW IN THE WEST

U.S. Department of Agriculture Forest Service

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a note to you

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on the cover

Charles Evans uses a tape recorder to note the species of each of the more than 100 different plants eaten by young deer during the morning and evening feeding trials. See "Scientists analyze deer decline" on facing page (photo courtesy William Noblitt, California State University, Fresno). *Inside:* photo page 17 courtesy Pete Wingle, Washington, D.C. *Back cover:* photo of deer, courtesy Ruth Evans.

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Scientists analyze deer decline

The recent downward trend in the numbers of deer in the Western U.S. has been especially evident in the North Kings deer herd of the southern Sierra Nevada mountain range in California. This herd has gone from an estimated 17,000 deer in 1954 to about 3,000 animals in 1973.

One of the scientists who is trying to determine the factors behind this downswing, and to reverse the trend, is Donald L. Neal, research range scientist with the Pacific Southwest Forest and Range Experiment Station in Fresno. Neal's studies are part of an intensive, 10-year cooperative program to develop techniques for managing deer habitat. The program was started in 1970 and is planned to run through 1980. Cooperators include the California Department of Fish and Game and organizations that manage land within the herd's range — the Sierra National Forest, Southern California Edison, and the National Park Service. Scientists from California State University, Fresno, are involved, as are members of the Fresno County Sportsmen's Club. The herd's 792-square mile range is entirely within Fresno County.

In cooperation with the Pacific Southwest Station, researchers from California State University, Fresno, observed young, domesticated deer to find out their preferred foods. (Photo courtesy William Noblitt, California State University, Fresno)

According to Neal, the information coming from this combined effort should be of interest and of use not only to scientists in California, but also to their co-workers in other Western States who are struggling with the deer decline dilemma.

Radio telemetry

In one study, Neal is examining competition between deer and cattle on portions of the range where ranchers are permitted to graze livestock. Neal is learning which sites and foods the cattle prefer, and comparing these choices with the space and forage needs of the deer. Colleague David L. Chesemore of California State University, Fresno, is providing the information on deer preferences.

In the summer of 1975, Neal used radio transmitters to track the movements of 10 cows. As far as he knows, this was the first experiment involving radio telemetry with cattle. He also fitted each animal with a bell and a numbered and color-coded collar. He observed the cows as often as possible, noting what each was eating, as well as where the animal was located, the ground cover and canopy at the site, the climate, and the growth stage of key plants in the area. The long-standing impression that cattle spend the summer in meadows apparently is not correct. "We found that the animals travel several miles a day," Neal says, "and that they eat something in almost every habitat type, not just in meadows." To find out the amounts of each forage species the cattle are consuming, Neal plans to study food samples taken from small containers that will be surgically inserted in the digestive tract, near the esophagus, of several range cattle next year.

Preferred forage of mule deer will be compared to the favorite foods of range cattle, in a study designed to help land managers meet the forage and habitat needs of both cattle and deer. (Photo courtesy Charles Evans, California State Univ., Fresno)

Under cooperative agreements with the Pacific Southwest Station, Dr. Chesemore, who is a biology professor at the University, is determining the foods the North Kings deer prefer on their summer range, migration corridors, and winter range. For these studies, he and his assistants — Charles Evans, Robert Haines, and William Noblitt — worked with deer that had been captured as fawns and tamed and raised especially for the experiments. The researchers trucked these domesticated deer to sites comparable to those being used concurrently by wild deer of the North Kings herd. During the "feeding trials" that followed, the researchers stayed close to the fawns and noted the species of every twig, leaf, and flower that the deer ate. The researchers also analyzed the botanical composition of the feeding sites. This information — the number of species and amount of space occupied by each — was needed so that calculations of preference would truly reflect preference, not just abundance. The experiments were patterned after deer study techniques designed by O. C. Wallmo, currently with Pacific Northwest Station at Juneau, Alaska, and D. J. Neff with the Arizona Game and Fish Department at Flagstaff.

Preferred forage

There are more than 800 different plants in the herd's range. Preliminary results indicate that the tame deer fed on more than 100 of these species. On brushy slopes and wooded portions of the summer range, they seemed to prefer mountain whitethorn (*Ceanothus cordulatus),* chinquapin (*Chrysolepis sempervirens),* and bitter cherry (*Prunus emarginata).* Meadow species that the deer liked during summer included an aster (*Aster foliaceous),* trefoil

(Lotus oblongifolius), sheep sorrel (*Rumex angiocarpus),* cinquefoil (*Potentilla glandulosa),* and knotweed (*Polygonum bistortoides).* During the winter trials, interior live oak (*Quercus wislizenii*), popcorn flower (*Plagiobothrys nothofulvus),* a filaree (*Erodium obtusiplicatum), Bromus* species, and spikerush (*Heleocharis)* made up a significant portion of the deer diet. On the spring migration route, favorites included Mariposa manzanita (*Arctostaphylos mariposa),* buck brush (*Ceanothus cuneatus),* deer brush (*Ceanothus integerrimus),* cinquefoil (*Potentilla glandulosa),* and *Brodiaea* species. Information from these studies should help land managers meet the site and forage needs of both deer and cattle.

In another study, Don Neal is trying to improve the quality and quantity of forage available to deer during their spring migration. "The herd usually takes three to six weeks to migrate from their winter range up to their summer grounds," he explains. "They could make the trip in one to three days, but their pattern has been to stop along the way at 'delay sites' or 'holding areas.'"

Tame deer used in the feeding trials were weighed and measured regularly. (Photo courtesy Ruth Evans)

Stopovers crucial

Ron Bertram, who is liaison for the California Department of Fish and Game in the North Kings program, explains that the stopover areas are important because does spend their last weeks of pregnancy at these sites. Bertram, an associate wildlife biologist with the Department, says that forage conditions at the holding areas may affect the health of the unborn fawns. Fawn survival, in turn, affects the size of the herd.

In order to be sure that the deer are getting nutritious forage at this crucial time, Neal is experimenting with seeding and fertilizing more than 20 forage species. "We're looking for plants that grow fast and early, so that the deer will have something to eat when they arrive at the holding areas in early spring," he says. "To be of any use, these species have to green-up long before the native plants." For this research, which he started in 1973, Neal established a network of deer-proof exclosures in representative segments of the migration corridors. These plots are from one-tenth to five-tenths acre in size, and are situated in sites ranging from 3,800 to 8,200 feet in elevation. At three of the plots, he is testing the effect various silvicultural practices have on forage. One plot is in an uncut forest; a second is on a clearcut site; and the third is within an area that has been selectively cut.

Dr. Ray Evans of the Agricultural Research Service in Reno, and other members of the ARS staff, have helped with these studies by analyzing germination of some of the more promising native species, and by conducting tests of soil fertility, experimenting with inoculation of seeds, and helping with evaluation of species success. Evans plans to help analyze microclimatic differences at the exclosures, to help determine why some species fail and others succeed.

During the summer of 1976, students with the Pacific Southwest Station's Youth Conservation Corps cleared brush and constructed new exclosures.

Foreign grasses

"We have found that it's possible to produce early and fast-growing forage in holding areas," Neal reports, "primarily by seeding grasses from Siberia and the Middle East. They are nutritious and are available up to 4 weeks earlier than native species. Legumes from Scandanavia, the Middle East, and Australia have shown promise. But, in the holding areas — the place where we need these legumes the most — we have not had nearly the success that the grasses gave us. We'll continue to study the legumes, however, because they are highly palatable and nutritious.

"We've also found that fertilizer can help produce early feed along the migration routes. Plants that are fertilized are ready 2 to 4 weeks earlier than those that have not received supplemental nitrogen. An added benefit is that the deer are staying a little longer in the areas with the early forage, and are thus giving the higher elevation plants some more time to develop. Fertilizer also has helped improve forage for the cattle. This is because deer seldom use all of a plant. The vegetation left in the area after they migrate responds to the residual effects of the fertilizer. This additional plant growth benefits the cattle that graze the range after the deer have left."

For further information on Don Neal's studies, write him at the Pacific Southwest Forest and Range Experiment Station, 1130 "O" Street, Fresno, California 93721, or phone him at (209) 487-5194 (FTS 467-5194). Details on the tame deer studies are available from David Chesemore, California State University, Fresno, Fresno, California 93740 (phone: (209) 487-2010 or (209) 487-2001).

—By Marcia Wood, Pacific Southwest Station

Editor's Note:

A research program similar to the one described in this article is also underway in Colorado's Middle Park. It is a cooperative effort involving the Colorado Division of Wildlife, Colorado State University, and Rocky Mountain Station. The focal point is improvement of winter range conditions to meet the nutritional needs of mule deer in late winter when food supplies in the Rockies are often most limited. For information on this research, write to Wayne L. Regelin at Rocky Mountain Station in Fort Collins, or phone (303) 482-7332 (FTS 323-5211).

A healthy larch stand growing adjacent to Hungry Horse Reservoir, Flathead National Forest.

Management of western larch forests

Western larch is one of the most important conifers of the northern Rocky Mountains. A primary source of sawlogs, it now leads all species except Douglas-fir in annual volume cut in the northern Rockies.

Obviously, more information on harvesting and regeneration is needed to effectively manage western larch forests. But today, management for timber production alone is not enough. Increasing demands for a variety of uses and a growing concern for the environment are changing the priorities of management.

The tall, straight larch adds to the beauty of the landscape, and it is valued for its ability to rapidly restock areas following wildfire and logging, thus protecting critical watersheds. A wide variety of wildlife, including grizzly bear, moose, elk, and deer, find protection and food in larch forests. The resulting interaction of uses, and specifically the effects of timber management on them, presents a new range of problems for silviculturists.

Studies of western larch are included in the program of the Intermountain Station's silvicultural research group, led by Wyman Schmidt at Bozeman, Montana.

Schmidt says, "Although past studies have provided much silvical and ecological information about larch forests, present and future research must broaden the base of knowledge for a more comprehensive approach toward forest management problems. Multidisciplinary studies, begun about 10 years ago, are providing information on silvicultural practices that can achieve not only timber production goals, but also meet other demands that compete for a shrinking land base."

Schmidt adds that previous low utilization standards combined with widespread insect and disease damage have made it difficult to dispose of logging debris. Logging residues can contribute nutrients to the soil, reduce erosion, protect seedlings, and provide cover for wildlife. However, they also can create a fire hazard, inhibit new growth, waste a fiber resource, and detract from esthetic values.

Thinning 9-year-old larch with a circular powersaw.

On-going studies

Working closely with the Intermountain Station's Forest Residues Utilization Program, Schmidt and his team are conducting studies to predict the effects of various logging methods, silvicultural systems, and post-logging practices on the effectiveness of site preparation and on seedling establishment. They also are taking a look at the impacts on the site itself.

According to Schmidt, the same conditions that have caused problems in logging and slash disposal have profound implications in fire management. Many land management practices — partial cutting, logging systems, and thinning practices — create undesirable fuels and residues. Land managers are concerned not only with problems of large fires but with the impacts of fire in maintaining or enhancing certain forest ecosystems.

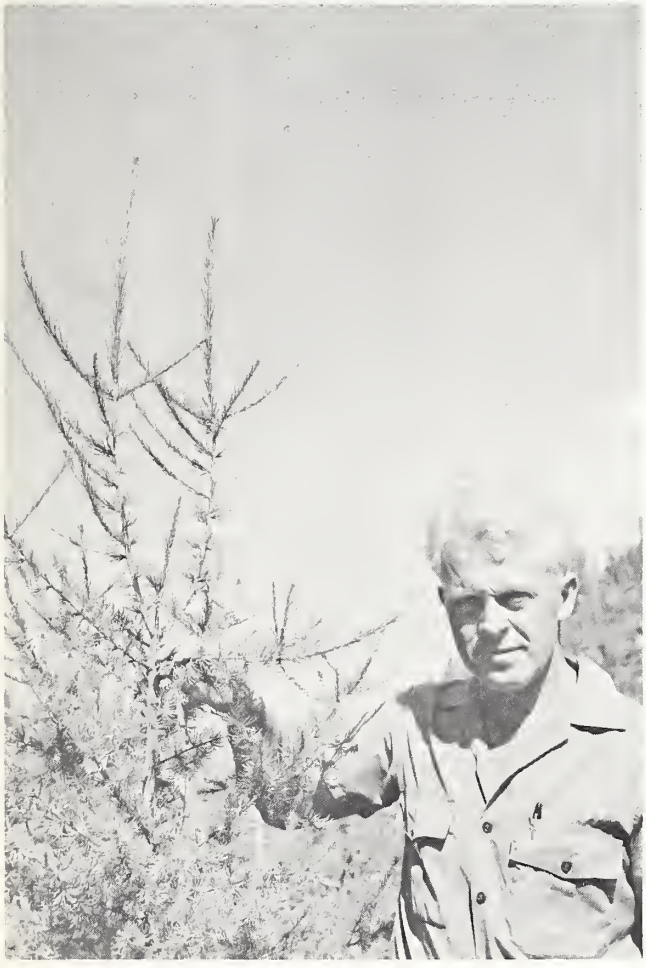
As management policies are modified to recognize the role of fire, the silviculturists are integrating their research with fire management objectives. They are studying the effects of prescribed burning, using basic as well as applied research. They want to know the effects of fire on natural and artificial regeneration

Strip thinning in a 30- to 40-year-old western larch and lodgepole pine stand.

and how regeneration relates to water use, nutrient conditions, and wildlife habitat values.

A summary report of current and past research on western larch forests that spans a period of 30 years is available from the Intermountain Station. The authors — silviculturists Schmidt, Raymond C. Shearer, and Arthur L. Roe — discuss their own research as well as that of cooperators and other Experiment Station scientists. The report presents detailed information describing biological, environmental, and economic values of western larch forests. Much of the research was done at the Coram Experimental Forest, located in northwestern Montana near Glacier National Park.

Development of forks in young western larch as a result of feeding damage by western spruce budworm.



Continuing research

The Bozeman unit is continuing some studies on stocking control in young larch stands and is increasing efforts in insect-host relationship studies. The researchers are giving high priority to the ecological and management consequences of larch casebearer and spruce budworm infestations, evaluation of alternative tree species for planting on larch sites, and effect of stand culture on insect infested larch.

Schmidt and his staff are constantly assessing the direction of their research to insure the development of knowledge needed to manage larch forests for current and future uses. They want to help achieve the most desirable silvicultural objectives in western larch stands — to control diseases; to establish natural reproduction within a 5-year period; to maintain larch in sites for which it is best suited; to use early stocking control to take advantage of rapid juvenile growth; and to optimize watershed, recreation, and wildlife habitat values.

The summary report, "Ecology and Silviculture of Western Larch Forests," (USDA Technical Bulletin 1520-FR9), is available from the Intermountain Station.

—By Delpha Noble, Intermountain Station

A strip thinning 1 year after treatment demonstrating the response of understory shrubs to increased light and moisture in the strips.

Fire scientist Bob Martin briefs the students before a field exercise.

Burning with respect

"There hasn't been a fire that we know of in this stand since 1902. But sooner or later another fire will start in the accumulated dead wood and duff. We want to burn now so we can control what happens."

Frank Lehto, a Forest Service fire specialist, was briefing 53 trainees in a workshop on prescribed burning on their final field exercise, an operational burn in a ponderosa pine forest.

After 3 days of training, the students had a far better understanding of the interrelationship of the various elements of an ecosystem. They understood that fire prescribed for any single purpose has complex effects on all parts of the ecosystem. Those effects last a long time and are not reversible. Mistakes can be serious.

With the trainees were two men who had organized and conducted the workshop: John Dell is a fuels management specialist with the Forest Service's Pacific Northwest Region in Portland, Oregon. Robert Martin is a project leader for Silviculture of Interior Forest Types, a research unit of the Pacific Northwest Station at Bend, Oregon. Martin was formerly an instructor in fire science at the University of Washington. Dell had recently taken a four-week training course in prescribed burning in Region 8 which included operational burns in the South.

Specialists

Dell and Martin had enlisted a faculty of specialists in botany, ecology, wildlife, meteorology, and prescribed burning, who had been with the students for three days, giving talks, conducting field exercises, demonstrating, explaining, even exhorting. Ecologist Fred Hall had been emphatic: "When someone asks about the effects of burning, you have to ask where and in what plant community. It is vital to consult the local experts in range, wildlife, plants, and soils to find out ahead of time what will happen if a particular site is burned."

This first workshop in the Pacific Northwest to include field experience in prescribed burning under a timber canopy, brought together employees of several agencies: the Forest Service, the Bureau of Indian Affairs, State Forestry Departments, the National Parks, and a Canadian forestry organization. Most of the students had been trained previously to put out fires. Now they were learning how to use fire safely to achieve specific management objectives.

Lehto talked about the tracts the students were about to burn on his district — the Crescent Ranger District of the Deschutes National Forest in Oregon. "Besides reducing the accumulated fuel, we want to discourage pine reproduction. The overstory stand is dense enough and still growing. We'd also like to stimulate the growth of snowbrush and bitterbrush to bring in more wildlife. We decided on burning instead of machine piling and burning to avoid damage to the pumice soil. As you know, burning in piles creates intense heat, and vehicles compact the soil."

Objectives

Setting objectives for the stand and deciding how to achieve them were steps the trainees themselves would take in the future. Today they were conducting a burn to achieve the objectives of the District and at the same time gaining practical experience. The trainees had been divided into four teams, each led by an instructor trained in prescribed burning.

Workshop organizers Bob Martin (left) and John Dell set a brisk pace.

The day before, they had practiced on 2- and 3-acre burns. Today they were to plan and conduct burns of 34 to 68 acres.

The District had made most of the preparations. Vehicles and equipment were in place. Men were standing by to control flare-ups and mop up afterward. Firelanes had been plowed around the plots to be burned. Snags to be saved for wildlife had been marked and sprayed with fire retardant. Local residents had been notified the burn was to take place, an important step because most people in central Oregon still expect the Forest Service to put out fires, not start them.

Since this was an operational burn on his District, Lehto gave instructions about equipment and safety. Cars would be parked facing downhill with keys in them. Cars moving would have lights on. Passengers were to get out and walk through thick smoke. All tools were to be returned to the road.

Trainees gathered for a field briefing thumb through their vegetation manuals.

Checking Vegetation

Part of the students' experience was to identify the vegetation and predict its response to fire. Len Volland, range ecologist, explained, "There are five plant communities here, and you will find the four plots to be burned are not all the same. There is a strong relationship to slope. As you climb up you will see more manzanita."

Armed with vegetation manuals and workbooks, the group scrambled to check the vegetation on their hillside plots. They decided that a light burn would accomplish the District's objectives. It would consume the dead vegetation and part of the duff. The young pines would be killed. The snowbrush and bitterbrush would sprout in response to heat. The thick bark of the large pines would not be damaged by a low intensity fire, but flame height had to be kept low to prevent crown scorching.

The teams worked out and wrote up their burn plans, mapping the directional exposure of the units, the slope position, and the degree of slope and type of terrain.

The meteorologist from the National Weather Service, in his mobile field unit, supplied essential information to the teams of trainees. He reported wind direction and speed, upper air movement, air temperature, relative humidity, and gave an on-the-spot weather prediction. The air was somewhat moist, the temperature cool, the winds moderate. Conditions were satisfactory.

Burning begins

Each team chose a burning pattern suitable for the plot. Most teams used a combination of patterns: strip head fire, which travels in front of the wind for short distances; backfire, which creeps backward into the wind; or flank fire, which burns across the wind. The torches were lit and burning began.

As smoke from the fires began to block out the blue sky, someone noticed a nuthatch building a nest near the top of a snag. The snag was ringed with retardant and would not burn, but the nuthatch didn't know that. Would she complete her nest or move away? The wildlife consultant wasn't sure. Some questions have not been answered yet, especially in the West where little prescribed burning has been done under tree canopies.

To find some of the answers from the Walker Mountain burn, Len Volland had installed permanent transects the week before. He plans to monitor vegetation response for several years, not only to follow results from the Walker Mountain burn, but to add to general knowledge about prescribed burning in the west.

The main purpose of the Walker Mountain burn was to approximate the effects of a low intensity natural fire by removing debris from the forest floor and turning it into nutrients available for new growth. This was the process by which many pine forests had been created and maintained since long before man began managing them.

The young pines were killed and the ceanothus and chinkapin were stimulated to sprout by heat of the fire.

The Ranger District provided men and equipment to control flare-ups and mop up after the burn.

Early burning

Even man's management has included planned burning. The Indians did it. So did the early stockmen. Farmers still burn. But, since the early 1900's, the efforts of most public agencies have been to prevent and suppress the large destructive wildfires that damage thousands of acres of forest and range. The benefits of fire were ignored. As dead vegetation piled up in the forests, becoming fuel for the devastating fires the agencies were trying to prevent, land managers became concerned and began to consider the possible benefits of controlled fire.

Prescribed burning was first used in the South in the 1930's, and its acceptance has gradually spread to other parts of the country. In addition to reducing the hazard of dead vegetation, burning is now also used to accomplish silvicultural objectives — preparing sites for seeding and planting, controlling insects and disease, and manipulating species — and to improve cattle forage, wildlife habitat and browse, and accessibility within stands.

Many foresters who have had experience with prescribed burning feel it is environmentally sound and is bound to become more important in the future. It is a dramatic and powerful tool — potentially effective if used with respect by trained people, but dangerous if abused.

Comments

Acceptance by foresters of prescribed burning in the West made the workshop both possible and necessary. There were more applicants than could be accepted, and annual sessions for the next several years are planned. Like the one held in 1976, future workshops will include field work. John Dell, one of the workshop organizers, feels this was an important feature. "The students had an opportunity to work on an operational burn — to get a feel for the whole process from the first steps in planning to completion. They now have a foundation on which to build," he said. Two of the instructors, fire scientists Jack Dieterich and Steve Sackett of the Rocky Mountain Station, felt that the Region-wide basis of the workshop reflected recognition of the importance of fuel management problems.

One of the students, Paul Haertel, of the Lava Beds National Monument in northern California, said he was reassured by the interest of other agencies in burning. For the past three years the Monument staff has been involved in a fire ecology research project with the University of Washington. They hope to work into a burning program to duplicate the natural cycle of fires in the area, burning every 7 to 10 years.

Bob Martin, who helped organize this workshop and has also been involved with the experimental burning at Lava Beds Monument, said he especially wanted the students to have field experience in addition to classroom work: "They found out it's not the same as slash burning. You can't hurry burning under a stand and stick to your objectives for flame and scorch height."

And what happened at Walker Mountain? Good fuel reduction was achieved. The young pines were killed. However, some of the larger lodgepole were also killed in an area that got a little hotter than planned. Conditions for wildlife were improved. Three months after the burn, Volland found deer at Walker Mountain, attracted by their favorite browse — sprouts from the root crowns of ceanothus. "It's like ice cream to them," he said.

—By Dorothy Bergstrom, Pacific Northwest Station

Challenging dwarf mistletoe

Dwarf mistletoe is widespread throughout the central Rockies and the Southwest where it affects ponderosa and lodgepole pine.

Dwarf mistletoe is a major problem for most forest managers and land owners in the West. This parasite annually causes more losses in wood fiber production in western forests than fire and insects combined. Timber stands infected with dwarf mistletoe grow only a fraction of the wood volume produced by healthy stands; and seedlings and saplings, especially those with main stem infections, are easily killed by the parasite.

The growth rates of infested stands are seriously reduced as dwarf mistletoe saps nutrients from host trees, and stimulates abnormal branch growths known as witches' brooms. Heavily infected trees are killed directly or may be weakened to the point where they succumb to attacks of secondary pests, particularly bark beetles. Wood quality in infected trees is reduced by large knots, by pitchy, distorted grain, and by lowered wood strength. Also, infected trees produce poorer seed crops than uninfected trees.

Two computer programs, SWYLD2 for Southwestern ponderosa pine and LPMIST for lodgepole pine, were recently developed by mensurationists and pathologists at the Rocky Mountain Forest and Range Experiment Station as an aid to foresters in managing both mistletoe-infected and healthy forests.

Program application

Using these programs, foresters can examine a number of alternatives for managing specific forest stands. Management tools, such as timing of thinnings, thinning levels, rotation ages, methods of harvesting, etc., can be considered. The cost for each alternative examined is only a few pennies.

In mistletoe-infected stands, the programs can be used to help decide on the best treatment to be applied to meet management objectives. Also, the programs can be used to compare yields and stand development in stands managed for maximum timber production vs. those managed primarily for other uses such as wildlife habitat, watershed protection, or recreational experiences.

Cliff Myers, former chief mensurationist and Carl Edminster, associate mensurationist

A vivid example of dwarf mistletoe taking its toll on mature ponderosa pine. The two trees on the left are near death.

These mistletoe berries are nearing maturity at which time they explode, shooting seeds to infect surrounding trees.

with the Rocky Mountain Station originated the concept for the programs and developed them by collecting stand data on over 200 ponderosa pine plots from the Southwest to the Black Hills of South Dakota. The plots included both healthy and mistletoe-infested trees.

Plant Pathologist Frank Hawksworth and former Plant Pathologist Paul Lightle, along with former Rocky Mountain Region Pathologist James L. Stewart, established plots throughout the central Rockies and the Southwest to obtain information on the growth impact of mistletoe and how fast the parasite spreads and intensifies in various types of stands. In addition, data on mistletoe behavior from several long-term permanent plots in the Southwest were utilized. Relationships were developed to model both the effect of mistletoe on the growth and mortality of infested stands and the rate of mistletoe build-up in the stands. The relationships were then incorporated into programs originally developed for healthy stands.

The use of the programs is simple and only a few standard stand characteristics are needed to run them:

- site index
- number of stems per acre
- average d.b.h.
- average stand age
- mistletoe situation; that is, percent of trees infected, average mistletoe rating, or age of infection.
- the forest manager's plans for the area, including thinning levels, thinning frequency, rotation age, and regeneration system.

Management example

The following example illustrates how these programs might be applied to an actual stand management situation; given a lodgepole pine stand 50 years old that is heavily infected with dwarf mistletoe, let us compare the expected yields if:

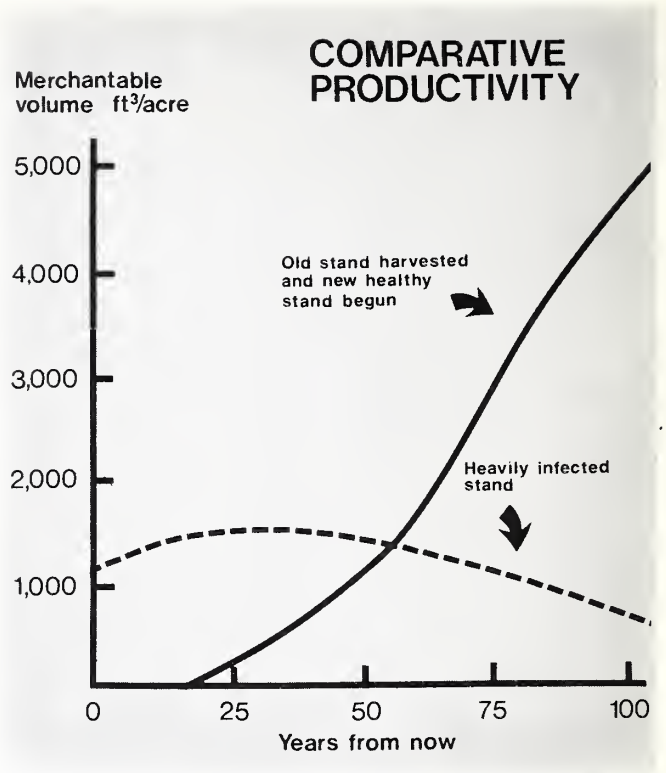
- nothing is done to the stand, or
- if the stand is salvaged now and a new, healthy stand is regenerated.

The accompanying graph shows the expected merchantable cubic foot yields under the two alternatives. If nothing is done to the stand, the present 1,000 cubic feet per acre will increase to approximately 1,600 in about 30 years, and then decline as mortality due to mistletoe takes its toll. On the other hand, if the present stand is salvaged and a new stand regenerated, there will be a progressive increase in volume. The yields in the new stand will surpass those from the untreated stand after about 50 years. After 100 years, yields in the new stand will be about 4,500 cubic feet per acre, or six times that in the untreated stand, even though it is 50 years younger.

This case is based on just two options for this stand. We could make the same type of analyses for cubic foot or board foot yields for many other combinations of thinning levels, thinning frequencies, and rotation ages.

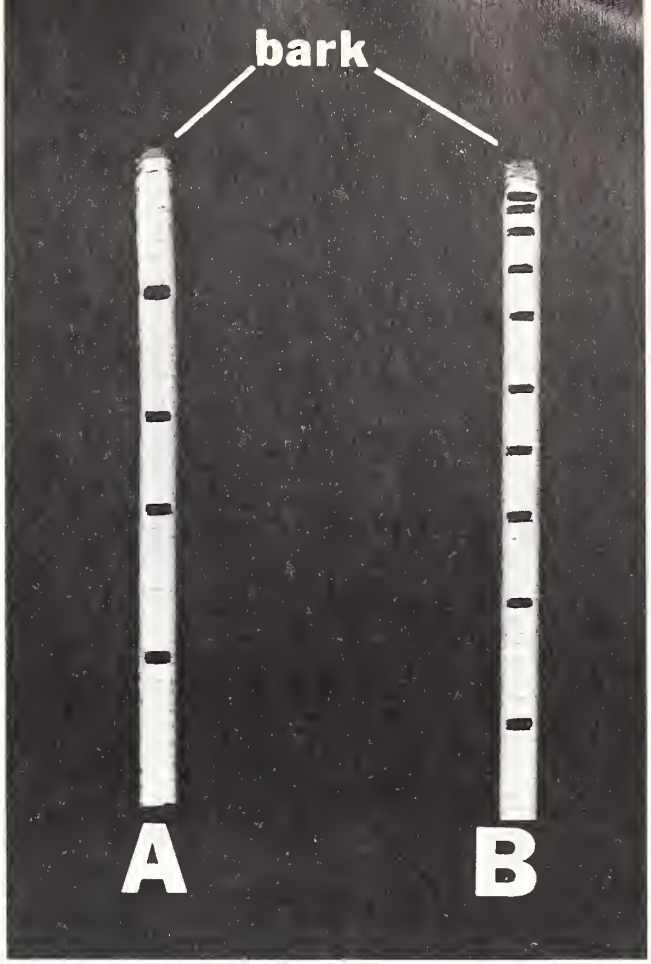
This, however, is only part of the story. Will the gains in yields economically justify the expense of harvesting and regenerating the new stand? A current economic study of dwarf mistletoe control, utilizing these yield programs, will provide forest managers with much needed cost-benefit information to help in making control decisions. This study is a cooperative effort between the Insect and Disease Management Unit of the Southwestern Region, the Intermountain Station, and the Forest Diseases and Montane Zone Multiple Use Work Units at the Rocky Mountain Station. Although the initial effort is with southwestern ponderosa pine, it is anticipated that the techniques for economic analyses developed will also be applicable to other forest types.

The yield programs described in this article are widely used in the central Rocky Mountains and the Southwest by the National



Comparative merchantable volume yields expected (1) in a heavily infected 50-year-old lodgepole pine stand and (2) if the stand was harvested and a new healthy stand begun.

SWYLD2 and LPMIST might suggest thinning as a management alternative for mistletoe-infected stands as in this lodgepole pine forest.



Hawksworth checks growth of infected tree by taking core samples (left photo). That sample (B), when compared to a healthy sample (A), tells the story. "A" represents 50 years growth, while "B" over 100 (each mark indicates 10 years). Note the increasingly compressed growth rings as the infected tree ages and nears death.

Forests, State Forest organizations, and the Bureau of Indian Affairs. The lodgepole pine program is being tested for applicability, and modification, if needed, in the northern Rocky Mountain and Intermountain regions.

Other programs

In addition, Rocky Mountain Station pathologists and mensurationists are cooperating with their counterparts at the Pacific Northwest Station to develop similar programs for dwarf mistletoe in ponderosa pine in that area. The programs also have potential for use in stands affected by other forest pests. Currently Station scientists are working with Rocky Mountain Region pathologists to develop a yield program for lodgepole pine stands infected with comandra blister-rust.

If you would like additional information on SWYLD2, LPMIST, and yield simulation and mistletoe research, the following publications are suggested and can be ordered from the Rocky Mountain Station.

Edminster, Carleton B., and Frank G. Hawksworth, 1976. User's Guide to SWYLD2: Yield Tables for Even-Aged and Two-Storied Stands of Southwestern Ponderosa Pine, Including Effects of Dwarf Mistletoe. USDA Forest Serv. Gen. Tech. Rep. RM-23-FR9. 8 p.

Myers, Clifford A., and Frank G. Hawksworth, and James L. Stewart, 1971. Simulating Yields of Managed, Dwarf Mistletoe-Infested Lodgepole Pine Stands. USDA Forest Serv. Res. Pap. RM-72-FR9. 15 p.

Myers, Clifford A., and Carleton B. Edminster, and Frank G. Hawksworth, 1976. SWYLD2: Yield Tables for Even-Aged and Two-Storied Stands of Southwestern Ponderosa Pine, Including Effects of Dwarf Mistletoe. USDA Forest Serv. Res. Pap. RM-163-FR9. 25 p.

Those who would like to talk directly with scientists involved in this research may phone Frank Hawksworth or Carl Edminster at the Rocky Mountain Station, (303) 482-7332 (FTS-323-5211).

—By Rick Fletcher, Rocky Mountain Station

Expanded wildlife research

The Rocky Mountain Station is strengthening its wildlife habitat research to find ways to correct habitat deficiencies confronting wildlife species in the Southwest.

The center for the expanded program is the Forest Hydrology Laboratory on the campus of Arizona State University, Tempe. Project leader for Habitat Criteria Development for Southwestern Wildlife is Dr. David R. Patton. The Semidesert Rangelands Research Unit at Tucson was recently combined with this wildlife project.

Research conducted by the wildlife unit will proceed on three fronts. One group of studies will focus on the habitat needs of threatened and endangered species associated with streams and surrounding vegetation in the Southwest. The second effort will complete studies already underway to classify habitat needed by small animals and nongame birds in southwestern ponderosa pine and mixed conifer forests. The third phase of the program will pull together existing information on deer and elk habitat in mixed conifer, ponderosa pine, and pinyon-juniper forests gathered during the past 2 decades.

Several universities, State resource agencies, other Federal agencies and other Forest Service management and research units are participating in the effort.

New wildlife unit established

The Rocky Mountain Station and Texas Tech University, Lubbock, are joining forces to find better ways to manage wildlife habitat and outdoor recreation resources in the Southern Great Plains by establishing a Forest Service Research Work Unit on the Lubbock campus.

The new Unit will augment the Rocky Mountain Station's Great Plains research programs, currently underway at Lincoln, Nebraska and Bottineau, North Dakota. Research at Lubbock will focus on wildlife habitat problems and economic opportunities associated with outdoor recreation, particularly hunting, in the Southern Great Plains — the Oklahoma Panhandle, West Texas, and eastern New Mexico. Most of the research will be conducted on a cooperative basis with Forest Service and University Scientists, graduate students, and private landowners participating. Other Federal, State and local resource agencies will become involved as the program develops. Initial research will include:

- Surveys of habitat conditions for upland game birds and waterfowl in portions of the Southern Great Plains.
- Studies on the effects of controlled fire on wildlife habitat and livestock range in the Western Rio Grande Plains.
- Analyses of past and present factors causing fluctuations in antelope populations in West Texas.
- Assessment of the economics of wildlife management as a revenue-producing activity in conjunction with agriculture in the Southern Great Plains.

Publications

Avalanche Handbook

Thousands of snow avalanches occur annually in the United States. Most go unnoticed by man. But, a number of them affect man by damaging property and transportation systems, injuring people, and even causing death.

The new "Avalanche Handbook" has just been published to help planners, managers, and developers reduce avalanche destruction. The handbook sets forth procedures for avoiding disasters in ski areas and towns, along roads, and in the back country. It is authored by Ronald I. Perla, former Rocky Mountain Station meteorologist, now with the Glaciology Division of Environment Canada in Alberta, and M. Martinelli, leader of avalanche research at the Rocky Mountain Station.

The book, in the making since 1972, discusses such topics as weather factors associated with avalanches; the nature of the avalanche phenomena; evaluating snow pack stability; protecting ski areas, highways and villages; rescue procedures; and safety in rescue operations and back country travel.

This handbook is a "must" for ski patrolmen, snow rangers, mountaineers, rescue teams, land managers and developers, and others who encounter avalanche conditions in their work.

The publication, which replaces Agriculture Handbook #194, "Snow Avalanches," is well illustrated with photos, diagrams and charts. It can be purchased for $3.95 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Request Agriculture Handbook #489, Stock #001-000-03466-9/Catalog #A1.76:489.

For the winter recreationist, a new brochure titled "Winter Recreation Safety Guide" is available from most Forest Service offices throughout the United States.

Grazing systems studied

One of the largest grazing studies ever undertaken by the Forest Service was begun in 1954 by researchers of the Pacific Northwest Station on the mountain range lands of the Starkey Experimental Forest and Range in eastern Oregon. The study was designed to provide results which would apply to the ponderosa pine-bunchgrass ranges.

The study had three objectives: (1) to determine the optimum number of cattle to graze per acre on mountain summer rangeland, (2) to compare the effect of season-long grazing vs. a rotation system, and (3) to evaluate plant response to stocking levels and grazing systems.

The study produced a number of important findings:

- Deferred-rotation grazing was superior to season-long grazing for improving forage and ground cover in forest openings.
- Elk sedge, the key forage species in open forest, was favored by moderate to light deferred-rotation grazing.
- Light stocking produced the largest weight gains per cow and calf; heavy stocking the poorest.
- As more cattle used the range, use by elk and deer decreased.

The results of the study were published recently in "Effects of cattle grazing methods on ponderosa pine bunchgrass range in the Pacific Northwest," (USDA Technical Bulletin No. 1531). It is authored by Jon M. Skovlin, Robert W. Harris, Gerald S. Strickler, and George A. Garrison, and is available from the Pacific Northwest Station.

A tally of National Forest grazing allotments in Oregon and Washington shows that since results of the study started to become available, over 60 percent of the allotments have dropped season-long grazing in favor of somewhat more sophisticated systems of grazing management.

Shelterbelt symposium

"Windbreaks should be an essential component of future programs geared to the conservation of natural resources and the stability and growth of the agricultural industry on the Great Plains." This is one of the many management suggestions which surfaced from over 50 papers presented at the Shelterbelts on the Great Plains Symposium, held in Denver, Colorado, April 20-22, 1976.

The symposium, conducted by the Forestry Committee of the Great Plains Agricultural Council, developed out of growing concern over the status of windbreaks and shelterbelts in the Great Plains, and the problems resulting from their removal.

Symposium topics covered such areas as the current status of legislation relating to shelterbelts; the function and use of windbreaks in the Great Plains; the effects of windbreaks on protection of farmsteads, livestock and man; current work relative to pest control and tree improvement; and the effects of windbreaks on agricultural systems.

These and other pertinent shelterbelt topics are presented in "Shelterbelts on the Great Plains: Proceedings of the Symposium," (Great Plains Agricultural Council Publication #78). Farm managers and landowners faced with windbreak decisions will find this publication helpful. It provides a base of information upon which plans can be drawn for optimum use of windbreaks on the Great Plains. Publication #78 is in limited supply and can be ordered from the Rocky Mountain Station.

Gully studies

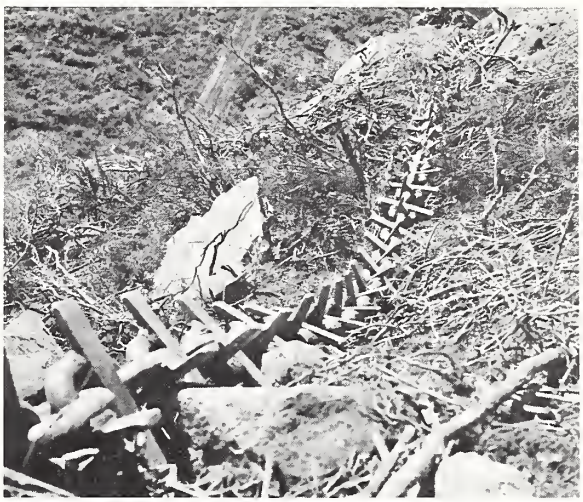
Gully cutting rapidly increased in the 1880's in the Western U.S. This was due primarily to the sharp increase in livestock grazing, and an exceptionally high frequency of intense storms during the previous decade. Gully erosion continues to plague land managers today.

Burchard H. Heede, hydrologist at the Rocky Mountain Station's lab in Tempe, Arizona, recently completed a status-of-our-knowledge paper entitled "Gully Development and Control," (Research Paper RM-169-FR9).

This paper summarizes available knowledge on gully formation and control, with emphasis on control. It discusses the objectives of gully control and the relationships between dams, sediment catch, and costs, as well as a critical review of construction procedures.

The discussion of gully control is based mainly on studies in the Colorado Rocky Mountains, where considerable effort has been invested since the 1930's.

The report is laced with many descriptive photographs and should aid the land manager in design and installation of gully treatments. It can be ordered from the Rocky Mountain Station.



Steel crossbars, welded at 90 degree angles to each other increase the chain's effectiveness in crushing brush.

How to beat chaparral

Land managers frequently need to modify, reduce, or eliminate some of the chaparral that covers more than 20 million acres of wildlands in the Western U.S. Modification of some of these brushfields may be needed for any of a dozen reasons — to reduce the fire hazard, improve the habitat for wildlife, produce better forage for livestock, or increase the recreation value of an area.

Most chaparral species are tough and persistent, and may require crushing, compacting, chopping, shredding, or a combination of these treatments. Wildland resource specialists in California who have tackled a combined total of 19 different chaparral modification jobs share their knowledge and experience in a new, 46-page guidebook, "Mechanical Methods of Chaparral Modification," (USDA Agriculture Handbook No. 487). The authors, George A. Roby, District Ranger on the Angeles National Forest in southern California, and Lisle R. Green, range scientist at the Pacific Southwest Forest and Range Experiment Station's Forest Fire Laboratory in Riverside, California, describe successes and failures involving the equipment most commonly used for brushland treatments. They give information on the capabilities, production rates, and costs of each method.

Because hand clearing is sometimes the only alternative in some areas, the authors include a short section on hand tools. They also present recommendations on equipment to use to seed grass by hand or by machine.

Included in the appendices are specifications on weight, horsepower, and gear speeds of tractors from 8 manufacturers, details on construction of the modified anchor chain, a suggested form for summarizing costs of chaparral modification, and a chart showing the relationship of production rate to swath width and machine speed.

The publication is illustrated with drawings and black and white photos. For copies, write the Pacific Southwest Station, Berkeley.

Probing attitudes toward wilderness fires

Forest managers are carefully reintroducing fire to its natural role in wilderness ecosystems, but does the public support the concept?

To gain information on public attitudes toward fire in wilderness, George H. Stankey, social scientist, Intermountain Station, questioned over 200 visitors to the Selway-Bitterroot Wilderness in Idaho and Montana. Results are presented in "Wilderness Fire Policy: an Investigation of Visitor Knowledge and Beliefs," (Research Paper INT-180-FR9), published by the Intermountain Station.

The responses showed that although most visitors favor suppression, a substantial minority favor a more natural role for fire. Few of those queried found either total suppression or no suppression acceptable. A major finding was that as a visitor's knowledge about the role of fire in ecosystems increases, so does the probability that he will advocate a more natural role of fire in wilderness.

Copies of Stankey's report are available from the Intermountain Station.

Research history in the Rockies

"In August 1908, the U.S. Forest Service began its formal timber management research with the establishment of the Fort Valley Forest Experiment Station near Flagstaff, Arizona. This was the first scientific venture of its kind in America — now the oldest." So begins a new Rocky Mountain Station publication titled "History of Forest Service Research in the Central and Southern Rocky Mountain Regions 1908-1975," authored by former Station Director Raymond Price.

General Technical Report RM-27-FR9, which can be ordered from the Rocky Mountain Station, contains historical reflections of people, places, and names dating from the early Fort Valley Station to research happenings in 1975. The report features the establishment of the Southwestern Station in 1930 at Tucson, Arizona; the Rocky Mountain Station in 1935 in Fort Collins, Colorado; and their merger into the current Rocky Mountain Station in 1953. Major research programs undertaken by these units are also described.

The publication is enhanced with a wide variety of historical and current photographs.

Checking blue grama range near boundary of Manzano National Forest, New Mexico. 1921

Container seedlings discussed

Some of the reasons for the move to container-grown nursery stock, some of the drawbacks, and important research needs are outlined in an article by William I. Stein, Jerry L. Edwards, and Richard W. Tinus. Reprints of "Outlook for Container-Grown Seedling Use in Reforestation," which appeared in the *Journal of Forestry* for June 1975 (73(6):337-341) are available from Publications Distribution, PNW Station.

Fiber from wastewood

An experimental process that removes bark from chipped trees and logging residues shows promise for improving the utilization of waste wood from forests in the Intermountain West.

Researchers Rodger A. Arola, North Central Forest Experiment Station, and John Host, Intermountain Station, used the process to evaluate the technical feasibility of removing bark from four Intermountain tree species. Samples of western larch, Douglas-fir, ponderosa pine, and lodgepole pine were chipped and then processed through the debarking system. Results showed that 70 to 80 percent of the wood fiber could be recovered from freshly chipped logging residue. Details of the evaluation are presented in "Debarking Chipped Logging Residues: Technique and Potential Impact," (Research Paper INT-179-FR9), available from the Intermountain Station.

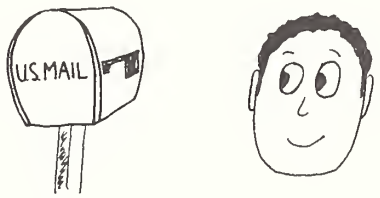
Developed in 1972 by the North Central Station's Engineering Laboratory at Houghton, Michigan, the method consists of steaming, compression debarking, and screening. The wood fiber produced meets pulp and paper industry standards for manufacture of a variety of products.

Improving timber measurements

Since the beginnings of scientific forestry, timber managers have endeavored to measure diameters of standing trees at selected points on the stem or bole with the greatest possible accuracy.

James E. Brickell, Intermountain Station mensurationist, tested the Barr and Stroud dendrometer currently used by many foresters under field conditions and reports the results in "Bias and Precision of the Barr and Stroud Dendrometer Under Field Conditions," (Research Paper INT-186-FR9). Included in the report are several suggestions to aid in obtaining satisfactory accuracy and precision.

If you would like detailed information about Brickell's study write to the Intermountain Station for a copy of the report.



Keep a close watch for our next issue. Feature articles will include information on: the Fire Meteorology Network; the Eisenhower Consortium; forest residues; and rehabilitation of surface mined land.

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